ADDRESSING THE STATE OF OHIO'S MEDICAID ELIGBILITY ERROR RATES THROUGH BLOCKCHAIN TECHNOLOGY

by
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A capstone project submitted to Johns Hopkins University in conformity with the requirements for the degree of Master of Arts in Public Management

Baltimore, Maryland
May 2021

Abstract

The State of Ohio's (State's) Medicaid program serves more than 3.1 million Ohioans. Despite more than a billion dollars in technology investments, the State eligibility determination processes continue to incorrectly determine eligibility at a significant rate. The resulting application backlog and improper payments put both beneficiaries at risk of not receiving necessary healthcare services and the State at risk of owing hundreds of millions of dollars in recoupment to the federal government. Internal and external audits have routinely identified a root cause as deficiencies in the State's technology solution.

This proposal presents a blockchain-based Medicaid eligibility solution as a viable technology investment to address current challenges in the eligibility determination process. Built on a blockchain infrastructure, the proposed solution uses hierarchical deterministic (HD) wallets to build beneficiary profiles, a series of smart contracts to streamline the determination process, and a system integration tool to allow for seamless integration into the State's Health and Human Services (HHS) system.

An independent review of global trends in blockchain technology signal that the disruptive technology is gaining mainstream attraction healthcare and government industries. Through assessing the advantages and disadvantages of blockchain technology, this proposal demonstrates that it can be a viable solution to addressing primary challenges with current technology. Further, introducing disruptive technologies aligns with the current administration's forward-thinking views on technology and its power in integrating citizen services. Based on these analyses, this proposal concludes that this solution be considered for adoption.

Advisor: Paul Weinstein

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TO: Maureen M. Corcoran, Director Ohio Department of Medicaid; Matthew Damschroder, Director Ohio Department of Administrative Services

FROM: Christopher Davis

RE: ADDRESSING THE STATE OF OHIO'S MEDICAID ELIGBILITY ERROR RATES THROUGH BLOCKCHAIN TECHNOLOGY

Action-Forcing Event

On January 17, 2020, the Ohio Department of Medicaid (ODM) issued a news release regarding the results of the Centers for Medicare and Medicaid Services (CMS) Payment Error Rate Measurement (PERM) audit for the Federal Fiscal Year (FFY) 2019.[1] The federal PERM audit found an error rate of 43.49 percent in the State of Ohio's (State's or Ohio's) Medicaid eligibility determinations, compared to a national rate of 20.60 percent.[2]

The State is required to reimburse the federal portion of the Medicaid payments for claims in the sample data paid in error.[3] Further, in the event that the State exceeds the allowable error rate threshold for two consecutive PERM audit cycles, the federal government may seek additional financial recoupment based on an extrapolation of the sample data.[4]

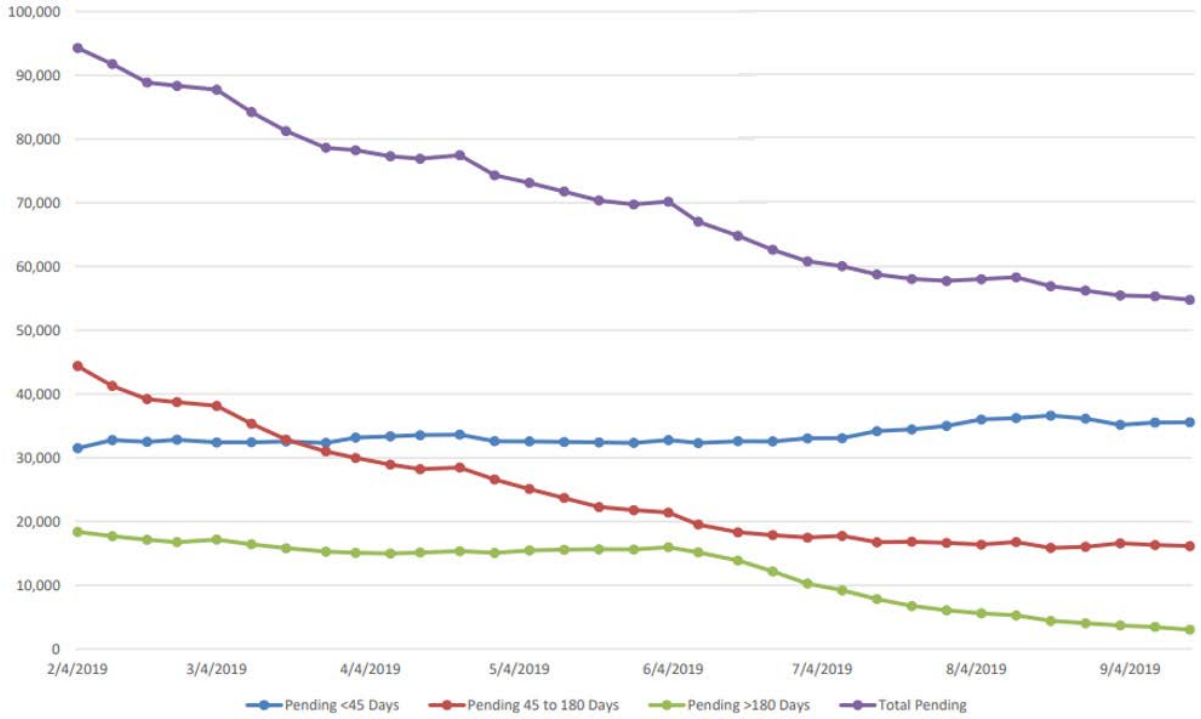
[1] Lisa Lawless, 2020, "Ohio Medicaid releases improper payment audit results," ODM, January 17, 2020, https://www.medicaid.ohio.gov/Portals/0/Press%20Releases/01-17-20ODMPERM%20PressRelease-FINAL.pdf.
[2] Ibid, 3.
[3] Ibid, 4.
[4] Ibid.

Statement of the Problem

Ohio's Medicaid eligibility and payment error rates have demonstrated an unstable environment in which beneficiaries are subject to undue burden through long application waiting periods, incorrect eligibility determinations, and improper payment dispositions. State staff are also subjected to a myriad of system defects and deficiencies leading to numerous manual workaround processes. Cost associated with improper payment dispositions can represent significant losses to Ohio Medicaid. Additionally, despite experiencing a reduction in its Medicaid application backlog, the State had 24,452 applications exceeding a 45-day processing time.[5] In a September 2019 presentation to the Joint Medicaid Oversight Committee (JMOC), the State presented data demonstrating a reduction in overall application backlog (figure 1); however, the number of pending applications had begun to generally level off.

[5] Ibid, 24.

Figure 1. Application Backlog Over Time. Maureen Corcoran, "Ohio Medicaid: DeWine Administration Priorities and Status Report to the JMOC" (presentation, Columbus, OH, September 19, 2019).



Although reducing application backlog from more than 90,000 to under 60,000 represents measureable gain, the leveling off signals that while promising, the initial efforts to ease the backlog would not do away with the State's backlog challenges.

Scope

The non-cost scope of the impact of the deficiencies in Ohio Medicaid's eligibility determination system and processes can be categorized in two ways: technical scope and user experience scope. The technical scope of the deficiencies refers to design and configuration of the State's integrated eligibility system (IES)—known as Ohio Benefits. User experience scope refers to end users who interact with Ohio Benefits and the supporting processes for Medicaid eligibility and enrollment services. User experience scope can be further classified by the beneficiary user and the staff user.

Technical Scope

In a January 2020 year-end summary memorandum, Medicaid Director Maureen Corcoran identified the most problematic technical deficiencies with Ohio Benefits. Figure 2 highlights the most problematic technical deficiencies.

Figure 2. Ohio Benefits Technical Deficiencies. Ohio Department of Medicaid, *2019 Year End Summary*, by Maureen Corcoran, Document No. 32811114 (Columbus, 2020), 5.

The Ohio Benefits system allows overwriting of eligibility data and documentation, eliminating the historical documentation needed to prove that member eligibility was properly established for audit purposes
The system is ascribing incorrect dates for renewals causing late renewals or in some cases failing to trigger a renewal at all
The system is allowing duplicate member identifications, potentially resulting in paying a managed care plan more than once for the same person
The system is not tracking whether it is properly submitting all required IRS forms
System errors have caused hundreds of privacy incidents where members received mail for other members and members have been able to access the portals of other members
The system sometimes incorrectly links newborns to individuals who are not their actual parents
The system allows multiple ways of inputting data such as "male," "m," "ma," or "2"

Further, at the time of the memorandum's release, the State was faced with approximately 1,100 system defects related to Ohio Benefits.[6] The system defects and deficiencies have led to countless workarounds necessary for State staff to perform the processes associated with Ohio Medicaid's eligibility determination.

User Experience Scope

Staff users include both State and County staff end users who would typically access Ohio Benefits' internal-facing application to handle eligibility applications and processes.

[6] Ohio Department of Medicaid, *2019 Year End Summary*, by Maureen Corcoran, Document No. 32811114 (Columbus, 2020), 4.

Beneficiary end users include both prospective and existing beneficiaries who would typically access Ohio Benefits through the online self-service portal.

Staff user experience

Staff end users face significant challenges when carrying out day-to-day tasks associated with the State's eligibility determination processes. The system defects and deficiencies described above have required the State and County staff end users to develop 1,765 workarounds.[7] In addition to the workarounds, Figure 3 presents additional impacts to State and County staff end users.

Figure 3. State and County Staff Impacts. Ohio Department of Medicaid, *2019 Year End Summary*, by Maureen Corcoran, Document No. 32811114 (Columbus, 2020), 5.

Many eligibility documents are hidden in tables accessible only by Medicaid's vendor and are not accessible by caseworkers, auditors, or Medicaid IT staff.
The system auto-populates new browser windows when a case worker does not close a prior case file. This results in the wrong data uploaded into a case file.
The system does not automatically prompt the caseworker to "ping the federal hub," which is a procedure to confirm citizenship and verify income
County workers are reporting that the Ohio Benefits system is causing some individuals' applications for benefits to disappear.

Beneficiary user experience

The Center for Community Solutions (CCS), a non-partisan think tank based in Cleveland, Ohio, conducted a user experience study in conjunction with Northern Ohioans for Budget Legislation Equality, Contact Center, and Ethiopian Tewahedo Social Services "to document and elevate the perspectives of Ohioans enrolled in public benefits."[8] CCS surveyed 151 low-income individuals and people of color across its study partners. The survey found that

[7] Ibid.

[8] Rachel Cahill and Hope Lane, *Prioritize Customer Needs in Ohio Benefits System: Findings and Recommendations from the Ohio Benefits User Experience Study* (Cleveland: Center for Community Solutions, 2020), 1.

only 25 percent of respondent beneficiary end users leveraged the Ohio Benefits online self-service portal to apply for or renew public benefits, compared to 93 percent of respondents who leveraged either the phone or in person processes to apply for or renew public benefits.[9]

Only 37 percent of respondents reported having a traditional home computer (or laptop) with internet access compared to 73 percent who said they have internet access via a mobile device.[10] Despite these findings, Ohio Benefits does not have an associated mobile application or a website in which the content is reformatted for mobile phones and tablets—known as a mobile optimized website.[11]

Cost

Ohio Medicaid's programs routinely make up the largest budget item in the State's Operating Budget General Revenue Fund (GRF). Ohio Medicaid's share of the SFY SFY-2020-2021 State Operation Budget GRF appropriation was $15,549,862,218 and $17,388,605,393 respectively, representing 45.87 percent and 48.45 percent of the State Operating Budget GRF. Table 1 provides a breakdown of the GRF appropriations by budget program.

Table 1. Ohio State Operating Budget appropriations (in millions)

Budget Program	SFY 2018	SFY 2019	SFY 2020	SFY 2021
K - 12 Education	$9,562.9	$9,728.3	$9,838.0	$9,754.0
HHS - Medicaid	$14,482.5	$14,825.6	$15,549.9	$17,388.6
HHS Non-Medicaid	$1,255.8	$1,309.9	$1,453.8	$1,470.1
Higher Education	$2,553.7	$2,596.9	$2,721.3	$2,807.4
Corrections	$1,940.3	$1,993.0	$2,069.5	$2,149.8

[9] Ibid, 10.
[10] Ibid, 11.
[11] Ibid.

Budget Program	SFY 2018	SFY 2019	SFY 2020	SFY 2021
General Government	$1,932.0	$2,045.9	$2,267.3	$2,321.7
Total	**$31,727.2**	**$32,499.6**	**$33,899.8**	**$35,891.6**
HHS – Medicaid Share (%)	**45.65%**	**45.62%**	**45.87%**	**48.45%**

Source: Data adapted from Legislative Budget Office, Main Operating Budget in Brief: House Bill 166 - As Enacted (Columbus, 2019).

The Ohio Medicaid budget appropriation includes both state and federal shares of program expenditures. The federal government bears a portion of Medicaid services through the Federal Medical Assistance Percentage (FMAP). For the SFY 2020-2021 budget cycle, the federal share of the GRF Medicaid appropriation represented 64.05 percent and 64.14 percent, respectively. Table 2 provides a breakdown of share of the Medicaid GRF appropriation by SFY.

Table 2. GRF Medicaid appropriations share by SFY (in millions)

GRF Share	SFY 2018	SFY 2019	SFY 2020	SFY 2021
State	$5,003.4	$5,192.7	$5,590.7	$6,236.1
Federal	$9,479.1	$9,632.9	$9,959.2	$11,152.5
Total	**$14,482.5**	**$14,825.6**	**$15,549.9**	**$17,388.6**
State Share (%)	**34.55%**	**35.03%**	**35.95%**	**35.86%**
Federal Share (%)	**65.45%**	**64.97%**	**64.05%**	**64.14%**

Source: Data adapted from Legislative Budget Office, Main Operating Budget in Brief: House Bill 166 - As Enacted (Columbus, 2019).

The Ohio Medicaid budget appropriation covers, among other line items, the State's share of the Medicaid benefit payments and program administration costs such as salaries. Additionally, and perhaps equally as important, it also includes the implementation and operational costs of the technology systems that drive Medicaid service delivery.

Given the size and scope of the Ohio Medicaid budget, deficiencies in one or more of the core technology systems introduces the possibility for significant monetary waste. As such, to understand the true financial implications of the Ohio Benefits system deficiencies, the improper Medicaid benefits payments must be examined in parallel to the underlying technology costs.

Improper Benefit Payment

On November 9, 2020, the Ohio Auditor of State's office published findings from its audit of the State's Medicaid eligibility determination process in State Fiscal Year (SFY) 2019. The Auditor of State's office conducted the audit because of the federal PERM audit, prior State Single Audits, and general concerns regarding the State's Medicaid eligibility determination.[12] The Auditor of State's audit tested 324 Medicaid recipients across 27 of the State's 88 counties and found that 4.9 percent of those audited received benefits despite being ineligible for Ohio Medicaid.[13] Extrapolating the error rate across the State's Medicaid population, the Auditor of State concluded that the State could realize potential losses to Ohio Medicaid of over $455 million in SFY2019.[14]

In addition to the potential losses identified by the Auditor of State, the United States Department of Health and Human Services (HHS) Inspector General estimated the total value of improper benefits payments based on payments to potentially ineligible beneficiaries resulting from errors in the eligibility determination process from October 1, 2014, through March 31, 2015. The HHS Inspector General estimated that the upper limit of the total value of the federal share of payments to potentially ineligible beneficiaries at $957,174,491.[15] This differs from the

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[12] Ohio Auditor of State, *Ohio's Medicaid Eligibility Determination Process*, by Kristi Erlewine, Report 157236 (Columbus, 2020), 1, https://www.ohioauditor.gov/auditsearch/detail.aspx?ReportID=157236

[13] Ibid, 1.

[14] Ibid.

[15] US Department of Health and Human Services, *Ohio Did Not Correctly Determine Medicaid Eligibility for Some Newly Enrolled Beneficiaries*, A-05-18-00027, by Christi A. Grimm (Washington, D.C., November 2020), https://oig.hhs.gov/oas/reports/region5/51800027.pdf

Auditor of State, which estimated the potential loss to Ohio Medicaid in the form of improper payments by extrapolating a verified sample payment error rate of 4.9 percent. Despite these differences, the range of potential improper payments represents significant financial loss.

Technology Cost

The Ohio Benefits information technology (IT) application—owned and operated by the State's contracted vendor, Accenture LLP (Accenture)—serves both the Ohio Department of Medicaid (ODM) and the Ohio Department of Jobs and Family Services (JFS).[16] The Ohio Benefits application was procured in 2012 and implemented in phases beginning in 2013, and it has cost the State and federal government $1.2 billion in total as of January 2020.[17]

[16] "State of Ohio Integrated Eligibility System: Integrating Service Delivery and Improving Outcomes for the Citizens of Ohio," case study (Accenture LLP, 2015), 2.
[17] Corcoran, *2019 Year End Summary*, 4.

History and Background

The concept of integrated eligibility was born out of the Patient Protection and Affordable Care Act (colloquially known as the Affordable Care Act or the ACA). Section (§) 1561 of the ACA directs the HHS secretary to coordinate with the Health Information Technology (HIT) Policy and Standards Committees to describe enrollment standards and protocols that support the enrollment of individuals in federal and state HHS programs.[18] These standards and protocols set the foundation for the advancement in Medicaid eligibility and enrollment systems. Table 3 provides a description of the parameters for the development of the standards and protocols described in § 1561.

Table 3. Standards and Protocol Requirements

Section	Description
§ 1561 (a)(1)	Electronic matching against existing Federal and State data, including vital records, employment history, enrollment systems, tax records, and other data determined appropriate by the Secretary to serve as evidence of eligibility and in lieu of paper-based documentation.
§ 1561 (a)(2)	Simplification and submission of electronic documentation, digitization of documents, and systems verification of eligibility.
§ 1561 (a)(3)	Reuse of stored eligibility information (including documentation) to assist with retention of eligible individuals.
§ 1561 (a)(4)	Capability for individuals to apply, recertify and manage their eligibility information online, including at home, at points of service, and other community-based locations.
§ 1561 (a)(5)	Ability to expand the enrollment system to integrate new programs, rules, and functionalities, to operate at increased volume, and to apply streamlined verification and eligibility processes to other Federal and State programs, as appropriate.
§ 1561 (a)(6)	Notification of eligibility, recertification, and other needed communication regarding eligibility, which may include communication via email and cellular phones.
§ 1561 (a)(7)	Other functionalities necessary to provide eligibles with streamlined enrollment process.

[18] Patient Protection and Affordable Care Act, Public law 111-148, 111th Cong., 2d sess. (May 1, 2010), § 1561.

Section	Description

Source: Patient Protection and Affordable Care Act, Public law 111-148, 111th Cong., 2d sess. (May 1, 2010), § 1561.

Additionally, § 1561 authorized the HHS secretary to "award grant to eligible entities to develop new, and adapt existing, technology systems to implement the HIT enrollment standards and protocols…"[19]

Funding Support

CMS announced that it would propose a rule to extend enhanced Federal Financial Participation (FFP) for Medicaid eligibility systems.[20] CMS published the final rule—Regulation in Number (RIN) 0938-AQ53—on April 19, 2011. The final rule modified sections of 42 Code of Federal Regulation (CFR) part 433 in order to accommodate extending enhanced FFP to Medicaid eligibility systems. Most notably, CMS modified § 433.112 to expand the definition of "claims" to encompass Medicaid eligibility determinations.[21] This modification allowed states to secure 90 percent FFP for the design, development, installation or enhancement of an eligibility determination system and 75 percent enhanced funding for maintenance and operations to those eligibility determination systems.[22] On December 4, 2015, CMS published a subsequent final rule (RIN 0938-AS53) revising the availability of the enhanced FFP "on an on-going basis."[23]

[19] Patient Protection and Affordable Care Act, § 1561.
[20] Centers for Medicare & Medicaid Services, "HHS Announces New Federal Support for States to Develop and Upgrade Medicaid IT Systems and Systems for Enrollment in State Exchanges," Press Release, November 3, 2010
[21] Centers for Medicare & Medicaid Services, "Medicaid Program; Federal Funding for Medicaid Eligibility Determination and Enrollment Activities: Final Rule," 76 *Federal Register* 21949 (April 19, 2011), 21,966, https://www.federalregister.gov/documents/2011/04/19/2011-9340/medicaid-program-federal-funding-for-medicaid-eligibility-determination-and-enrollment-activities#h-23.
[22] Ibid.
[23] Centers for Medicare & Medicaid Services, "Medicaid Program; Federal Funding for Medicaid Eligibility Determination and Enrollment Activities: Final Rule," 80 *Federal Register* 75,817 (December 4, 2015), 75,820, https://www.federalregister.gov/documents/2015/12/04/2015-30591/medicaid-program-mechanized-claims-processing-and-information-retrieval-systems-9010#h-10.

In order to qualify for funding, the final rule reiterates that states' Medicaid technology investments meet certain conditions described in regulatory and subregulatory guidance. Table 4 describes those conditions, known as CMS' Seven Standards and Conditions.

Table 4. CMS Seven Standards and Conditions

Standards and Conditions	Description
Modularity Standard	Use of a modular, flexible approach to systems development, including the use of open interfaces and exposed application programming interfaces; the separation of business rules from core programming; and the availability of business rules in both human and machine readable formats.
MITA Condition	Align to and advance increasingly in MITA maturity for business, architecture, and data.
Industry Standard Condition	Ensure alignment with, and incorporation of, industry standards: the Health Insurance Portability and Accountability Act of 1996 (HIPAA) security, privacy and transaction standards; accessibility standards established under section 508 of the Rehabilitation Act, or standards that provide greater accessibility for individuals with disabilities, and compliance with Federal civil rights laws; standards adopted by the Secretary under section 1104 of the Affordable Care Act; and standards and protocols adopted by the Secretary under section 1561 of the Affordable Care Act.
Leverage Condition	Promote sharing, leverage, and reuse of Medicaid technologies and systems within and among States.
Business Results Condition	Support accurate and timely processing of claims (including claims of eligibility), adjudications, and effective communications with providers, beneficiaries, and the public.
Reporting Condition	Produce transaction data, reports, and performance information that would contribute to program evaluation, continuous improvement in business operations, and transparency and accountability.
Interoperability Condition	Ensure seamless coordination and integration with the Exchange (whether run by the State or Federal government), and allow interoperability with health information exchanges, public health

Source: Centers for Medicare & Medicaid Services, "Medicaid Program; Federal Funding for Medicaid Eligibility Determination and Enrollment Activities: Final Rule," 21966-67.

The Seven Standards and Conditions set the baseline technological requirements for a state to secure enhanced funding for the design, development, installation, or enhancement of an eligibility determination system. At the time of the final rule's adoption, CMS required that a state incur the costs related to the "design, development, installation or enhancement" activities

by December 31, 2015, to be eligible for 90 percent FFP.[24] On December 4, 2015, CMS published a subsequent final rule (RIN 0938-AS53) revising the availability of the enhanced FFP "on an on-going basis."[25] States who continued to meet the Seven Standards and Conditions would retain the 75 percent FFP for the maintenance and operation of their eligibility determination systems on an ongoing basis.[26]

State Procurement Efforts and Contract Award

On August 6, 2012, the State Office of Health Transformation (OHT) released Request for Proposals (RFP) 0A1103 for integrated eligibility and HHS business intelligence. OHT and the State's HHS agencies sought to replace the State's then-34 year old eligibility system known as Client Registry Information System-Enhanced (CRIS-E).[27] The State required prospective technology vendors to submit replies to the RFP no later than October 5, 2012. Five technology vendors submitted on time replies—Accenture, Deloitte Consulting LLP (Deloitte), Infosys Public Services, Unisys Corporation, and Vendita Technology Group.[28] On February 1, 2013, the State awarded the resulting contract 0A1103 to Accenture.[29] The contract between the State and Accenture expires on June 30, 2021.[30]

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[24] Ibid.

[25] Centers for Medicare & Medicaid Services, "Medicaid Program; Federal Funding for Medicaid Eligibility Determination and Enrollment Activities: Final Rule," 80 *Federal Register* 75,817 (December 4, 2015), 75,820, https://www.federalregister.gov/documents/2015/12/04/2015-30591/medicaid-program-mechanized-claims-processing-and-information-retrieval-systems-9010#h-10.

[26] Ibid.

[27] Office of Health Transformation (OHT), *Integrated Eligibility and HHS Business Intelligence*, Request for Proposal 0A1103 (Columbus, 2012), 8.

[28] "Integrated Eligibility and HHS Business Intelligence," Procurement Opportunity Search Detail, Department of Administrative Services, https://procure.ohio.gov//proc/viewProcOpps.asp?oppID=9725

[29] Department of Administrative Services (DAS), *A Contract Between the Department of Administrative Services on Behalf of the Department of Jobs and Family Services and Accenture LLP*, Contract 0A1103 (Columbus, 2013).

[30] "Integrated Eligibility and HHS Business Intelligence," Current Contract Detail, Department of Administrative Services, https://procure.ohio.gov/proc/viewContractsAwards.asp?contractID=32138.

Ohio Benefits Design, Development, Installation, and Operations

Accenture developed and installed Ohio Benefits in a phased approach consistent with the RFP to ensure that the State was able to support Medicaid expansion and new rules regarding early enrollment for Modified Adjusted Gross Income (MAGI) eligible individuals. This first phase of the Ohio Benefits development and installation went online in October 2013.[31] The enhancements necessary to expand Ohio Benefits to the remaining Medicaid population went online prior to the December 31, 2015 deadline for incurring costs eligible for enhanced FFP of 90 percent. In addition to the remaining Medicaid benefits recipients, the Ohio Benefits enhancements expanded support to Temporary Assistance for Needy Families (TANF) and Supplemental Nutrition Assistance Program (SNAP), among other CRIS-E programs.[32]

Addressing Ohio Benefits Deficiencies

Ohio Benefits System Maintenance and Operations

Since the completion of the phased installation in 2015, Accenture has continued to manage and operate Ohio Benefits under the terms of its contract with the State. Accenture utilizes its release management process—Accenture Development Management (ADM)—to manage system updates from development stage to final release. Releases fall into one of three categories: Development, Maintenance, and Emergency. Table 5 describes each of these release categories.

Table 5. Release Management Categories

Release Category	Description
Development (Major) Release	Changes that provide a major impact to the client's

[31] "State of Ohio Integrated Eligibility System: Integrating Service Delivery and Improving Outcomes for the Citizens of Ohio," 2.
[32] Ibid.

Release Category	Description
	environment and require more significant time to develop, test and implement
Maintenance Release	Standard changes placed into scheduled service packs; for example, monthly maintenance release
Emergency Release	Changes immediately needed to be moved into production. These are done on short notice when a critical change is identified as part of the Incident Management process

Source: Accenture LLP, "Integrated Eligibility and HHS Business Intelligence Procurement Opportunity 0A1103," *Technical Response* (Indianapolis: 2012), 1463.

In part, system releases serve as a way for the State and Accenture to incorporate newly available system functions and enhancements and address system defects discovered through the course of normal business activities. The release management process incorporates a system defect and issue management plan that describes how the State and Accenture identify, escalate, and resolve a system defect (or issue).[33] The release management process, among others, serves as a primary vehicle for resolving problems with Ohio Benefits. As of the drafting of this memorandum, Accenture is planning its fourth major release in concert with multiple maintenance and minor releases.[34]

Administrative

ODM has taken multiple steps to address both the human and technical factors contributing to the deficiencies with the State's Medicaid eligibility determination processes. Beginning in February 2019, ODM has worked with county-level agencies and staff to address the human error component of the State's Medicaid eligibility determination processes and

[33] Accenture LLP, "Integrated Eligibility and HHS Business Intelligence Procurement Opportunity 0A1103," 1470.
[34] Department of Administrative Services (DAS), *Independent Verification and Validation Services to Support Enterprise Initiatives*, Request for Proposal 0A1261 (Columbus, 2012), 21.

conducted onsite visits to county agencies in an effort to help reduce their respective backlogs, achieving a reduction of 70 percent.[35]

Further, ODM created a unit within the agency to focus on county engagement and began prioritizing reports necessary for county workflows.[36] ODM added additional State staff to its Central Processing Unit to support its county-level agencies and additional State staff support trouble shooting efforts and provide overall technical assistance.[37] The State also reorganized internal project teams in order to provide a more integrated approach to system management.[38] This effort has included joint management among stakeholder agencies—ODM, the Department of Administrative Services (DAS), and JFS—which include recurring executive-level meetings.[39]

In addition to working with county-level agencies, ODM has worked closely with CMS to address federal audit findings. ODM holds weekly meetings with CMS to discuss the status of its corrective action plans and continues to work with CMS to identify and prioritize system repairs to address Ohio Benefits system defects and deficiencies.[40]

Technical Assessment

On September 18, 2020, the State released an RFP to contract with a vendor to perform a technical assessment of Ohio Benefits.[41] The technical assessment's aim is to achieve the following objectives:[42]

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[35] Corcoran, *2019 Year End Summary*, 4.
[36] Maureen Corcoran, "DeWine Administration Priorities and Status Report to the Joint Medicaid Oversight Committee" (Presentation to the Joint Medicaid Oversight Committee, Columbus, September 19, 2019).
[37] Ibid.
[38] Corcoran, "DeWine Administration Priorities and Status Report to the Joint Medicaid Oversight Committee"
[39] Ibid.
[40] Corcoran, *2019 Year End Summary*, 4.
[41] "Technical Assessment of the Ohio Benefits System RFP," Procurement Opportunity Search Detail, Department of Administrative Services, https://procure.ohio.gov/proc/viewProcOpps.asp?oppID=21903
[42] Ibid.

- Review the Ohio Benefits infrastructure and document risks due to physical hardware, system software version / configuration, availability, performance, and capacity. Provide recommendations to address infrastructure risks based on best practice and industry standards for each risk identified.
- Review the Ohio Benefits application to document risks due to design and code. Provide recommendations to address application risks based on best practice and industry standards for each risk identified.
- Review the management of the Ohio Benefits system including new functionality implementation and run operations and provide actionable recommendations to improve the operation of the system based on best practice and industry standards for each risk identified.

The State awarded the technical assessment contract to CMA Consulting Services (CMA) on February 23, 2021.[43] The current estimated deadline for the CMA to complete the technical assessment is June 30, 2022.[44]

[43] "Technical Assessment of the Ohio Benefits System RFP," Opportunity Updates, Department of Administrative Services, https://procure.ohio.gov/proc/viewWhatsNewSolicitations.asp.
[44] Ibid.

Policy Proposal

This policy proposal seeks to achieve three primary policy goals: (1) reduce the State's Medicaid eligibility determination error rate; (2) reduce the number of applications taking longer than 45 days to process; and (3) reduce the number of system defects. In addition to these stated primary policy goals, the technology solution described in this proposal can lead to ancillary benefits relating to data management and quality, a reduction in manual touch processes, and a greatly improved user experience.

Technology Solution

The proposed policy centers on the investment in Medicaid technology services to design, develop, and install a new blockchain-based Medicaid eligibility application to replace the existing Ohio Benefits. Further, the proposal builds, installs, and operates the blockchain-based Medicaid eligibility application in the State-owned cloud platform consistent with Executive Order 2019-15D, which requires cabinet level agencies to "migrate websites, online portals, and other points of online interaction to the InnovateOhio Platform."[45] IOP is an Amazon Web Service (AWS)-based platform, which offers multiple blockchain solutions to AWS customers.[46]

Blockchain Technology

Blockchain—a type of Distributed ledger technology (DLT)—is a "shared, immutable ledger that lets you record the history of transactions."[47] Blockchain is most instantly recognized as the supporting infrastructure for cryptocurrencies such as Bitcoin (BTC) and Ether (ETH).

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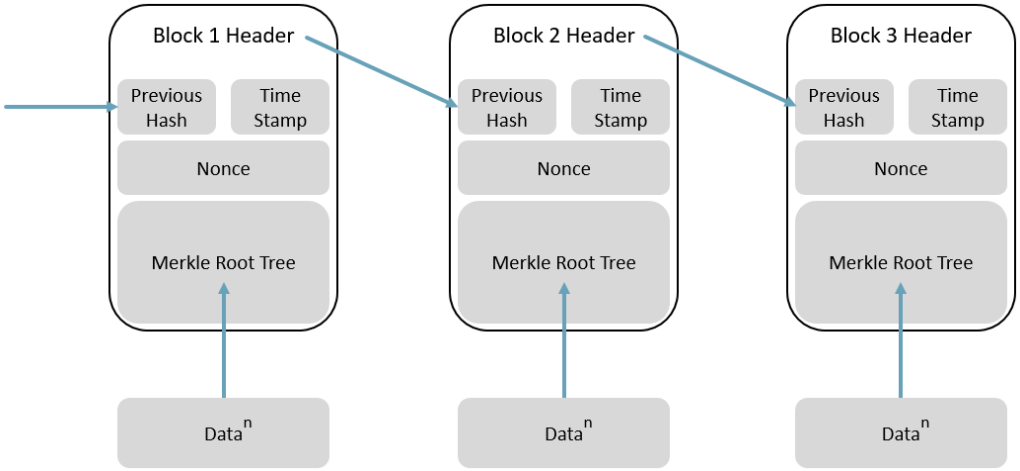
[45] Mike DeWine, Executive Order 2019-15D, "Modernizing Information Technology Systems in State Agencies," *Office of the Governor of Ohio*, https://governor.ohio.gov/wps/portal/gov/governor/media/executive-orders/2019-15d

[46] "Blockchain on AWS," Amazon Web Services, accessed on March 12, 2021, https://aws.amazon.com/blockchain/?nc2=h_ql_prod_bl

[47] Brittany Manchisi, " What is blockchain technology?," Blockchain Pulse (blog), *IBM*, July 31, 2018, https://www.ibm.com/blogs/blockchain/2018/07/what-is-blockchain-technology/

Blockchain is a chain of blocks stored on numerous servers distributed over a geographical area. The blockchain acts as a ledger that maintains a complete copy of all of the transactions of a particular digital asset.[48] Each block on the blockchain stores critical data related to the transaction it represents and is secured through a mathematical function known as cryptographic hashing. Figure 4 shows the basic structure of a blockchain.

Figure 4. Basic Blockchain Structure. Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System* (2008), https://bitcoin.org/bitcoin.pdf



Users interact with a blockchain through the use of wallets. Wallets are software applications that allow the user to send and receive digital assets.[49] A digital asset is not limited to cryptocurrency, and can include contracts, data records, or any other valuable information that can be digitized. The wallet is secured through public-key cryptography. When a user creates a transaction on a blockchain using their wallet, a block representing that transaction is created. Once a block is created, the requested transaction is broadcasted over the network, consisting of

[48] Toshendra Kumar Sharma, "A Comprehensive Guide to Blockchain Principles and Data Protection," (blog) *Blockchain Council*, https://www.blockchain-council.org/blockchain/a-comprehensive-guide-to-blockchain-principles-and-data-protection/

[49] "Blockchain on AWS," Amazon Web Services

computers, known as nodes, which then validate the transaction.[50] Once the transaction is validated, the associated block is combined with other blocks on the blockchain.[51]

Core Solution Components

The blockchain-based Medicaid eligibility application would require three core technical components in addition to a user interface (UI). The UI will be the main point of access for both potential beneficiary end users and staff end users. Further, any UI proposed should include a mobile application or a mobile optimized website. Kathi Vian, Alessandro Voto, and Katherine Haynes-Sanstead of the Blockchain Lab at the Institute for the Future describe a smart health profile in their paper, "A Blockchain Profile for Medicaid Applicants and Recipients," which severs as the conceptual basis for the blockchain-based Medicaid eligibility application. The proposal modifies their enabling technologies to present three core technical components: hierarchical deterministic (HD) wallets, smart contracts, and system integration services.

HD Wallet

The HD wallet is an evolution of the standard blockchain wallet. Previously, this proposal introduced the wallet and the means by which it is secured—public-key cryptography. With early generation wallets, the public key, which is a wallet's public address used to facilitate transactions, is unchanged (or static). This public key is combined with a password-like private key (ostensibly known only to the account holder) to validate the transaction activity. Conversely, an HD wallet uses an algorithm to generate new keys for each transaction from an originating seed.[52]

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[50] Nitish Srivastava, "What Is A Blockchain and How Does It Work?" (*blog*) Blockchain Council, https://www.blockchain-council.org/blockchain/what-is-blockchain-technology-and-how-does-it-work/

[51] Ibid.

[52] Kathi Vian, Alessandro Voto, and Katherine Haynes-Sanstead, "A Blockchain Profile for Medicaid Applicants and Recipients," *Institute for the Future* (Palo Alto: 2016), 7.

Smart Contract

The second core technical component of the blockchain-based Medicaid eligibility application is the smart contract. A smart contract is a "computer code that automatically executes all or parts of an agreement and is stored on a blockchain-based platform."[53] The smart contract function allows for instructions and data inputs and subsequent outputs to be validated and executed by the node network on the blockchain. As a result, smart contracts can be understood as 'if/when-then' statements. These 'if/when-then' statements can be used to describe eligibility criteria, with the smart contract sending a 'yes' token in response to a "passed" eligibility check and 'no' token in response to "failed" eligibility check. For example, in responding to an income level question, if annual income is less than or equal to $17,131 when household size is one, then the user passes the eligibility check and the input generates a 'yes' token.

System Integration

Finally, in order to make an eligibility determination, the blockchain-based Medicaid eligibility application must integrate with the necessary third-party databases. For this, a system integration service can interact with the blockchain and third party systems via Application Programming Interfaces (APIs), which allows two discrete systems to interact with one another. Vian, Voto, and Haynes-Sanstead describe this service as an "oracle service."[54] This system integration service allows the blockchain-based Medicaid eligibility application to not only verify

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[53] Stuart D. Levi and Alex B. Lipton, "An Introduction to Smart Contracts and Their Potential and Inherent Limitations," Harvard Law School Forum on Corporate Governance, Harvard Law School, May 26, 2018, https://corpgov.law.harvard.edu/2018/05/26/an-introduction-to-smart-contracts-and-their-potential-and-inherent-limitations/

[54] Vian, Voto, and Haynes-Sanstead, "A Blockchain Profile for Medicaid Applicants and Recipients," 8.

eligibility determination questions against existing State and federal databases, but against the Medicaid Management Information System (MMIS) responsible for paying Medicaid claims.

Policy Authorization Tool

This proposal would be authorized through the State's budget process by incorporating language directing relevant agencies to make a new Medicaid IT investment into the legislative bill establishing the operating budget. The State authorized Medicaid IT investments in the two previous biennial operating budgets. In House Bill (HB) 49, establishing the SFY 2018-2019 operating budget, the legislature included language mandating ODM invest in developing and implementing improvements to its Provider Network Management (PNM) system. § 5164.29 mandated that:

> Not later than December 31, 2018, the department of medicaid shall develop and implement revisions to the system by which persons and government entities become and remain medicaid providers so that there is a single system of records for the system and the persons and government entities do not have to submit duplicate data to the state to become or remain medicaid providers for any component or aspect of a component of the medicaid program, including a component or aspect of a component administered by another state agency or political subdivision pursuant to a contract entered into under section 5162.35 of the Revised Code. The departments of aging, developmental disabilities, and mental health and addiction services shall participate in the development of the revisions and shall utilize the revised system.[55]

Additionally, § 5167.24(A) in HB 166 (operating budget for SFY 2020-2021) mandated that:

> If the department of medicaid includes prescribed drugs in the care management system as authorized under section 5167.05 of the Revised Code, the medicaid director, through a procurement process, shall select a third-party administrator to serve as the single pharmacy benefit manager used by medicaid managed care organizations under the care management system. The state pharmacy benefit manager shall be responsible for processing all pharmacy claims under the care management system. The department of medicaid is responsible for enforcing the contract after the procurement process.[56]

[55] Creates FY 2018-2019 operating budget, Ohio H.B. 49, 132nd Leg. (OH 2017).
[56] Creates FY 2020-2021 operating budget, Ohio H.B. 166, 133rd Leg. (OH 2019).

This precedent provides the relevant State agencies the vehicle to secure budget authorization for investing in a new integrated eligibility system.

Authorizing language

In order to allow ODM and DAS the greatest amount of flexibility in addressing the deficiencies with the Ohio Benefits system, language is best modeled off language incorporated into both HB 49 and HB 166. Combining aspects of each provision will allow ODM and DAS to leverage the State's procurement processes to secure new Medicaid IT. Accordingly, the following sample language demonstrates how this may be achieved:

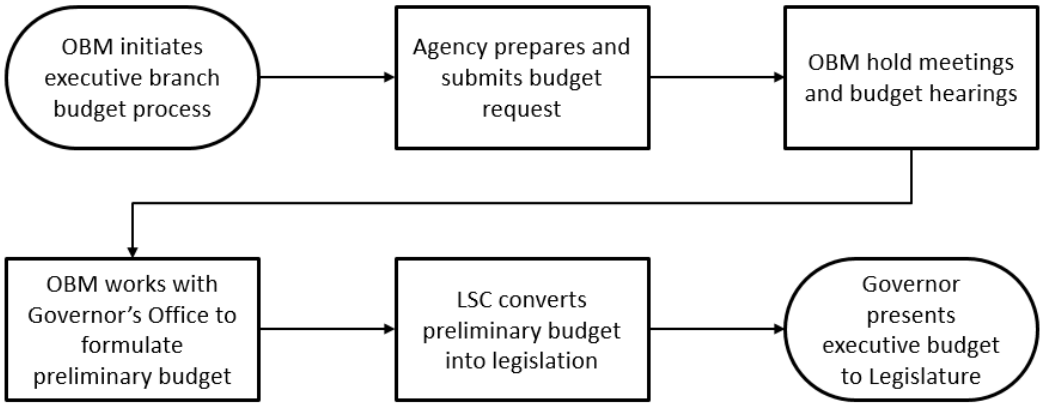
> Not later than June 30, 2023, the medicaid director, through a procurement process, shall select a third-party administrator to provide the state an integrated eligibility system by which persons become and remain enrolled in state and federal HHS programs so that there is a single system of record for the system and persons do not have to submit duplicate data to the state to become or remain enrolled in state and federal HHS programs, including a component or aspect of a component administered by another state agency or political subdivision. The department of medicaid, in coordination with the department of administrative services, is responsible for enforcing the contract after the procurement process. The department of jobs and family services shall participate in the development of the revisions and shall utilize the revised system.

Executive Budget Process

The budget language should be offered as part of the ODM budget request during the executive branch budget process. In that process, the Office of Budget and Management (OBM) submits instructions to agencies receiving appropriated funds on the process and format for budget requests.[57] Figure 5 gives a high-level overview of the executive branch budget process.

[57] Legislative Service Commission (LSC), *A Guidebook for Ohio Legislators*, edited by Kathleen Luikart and Kristin Rhee, 17th ed. (Columbus, 2021), 88, https://www.lsc.ohio.gov/documents/reference/current/guidebook/17/Chapter%208.pdf

Figure 5. Executive Branch Budget Workflow. Legislative Service Commission (LSC), *A Guidebook for Ohio Legislators*, edited by Kathleen Luikart and Kristin Rhee, 17th ed. (Columbus, 2021), 88.



By tradition, bills are introduced to the House of Representatives (House) of the State legislature—the Ohio General Assembly. Once introduced, the bill is referred to the full Finance Committee and its subcommittees for further work. This process is then repeated in the Senate. In the event that the House and Senate versions of the operating budget differ, the bill is referred to a conference committee for final review.

Federal Funding Authorization

In order to receive enhanced FFP for the design, development, installation, and operation of the prospective system, ODM must formally request—and receive approval—from CMS.[58] State's handle this prior approval request through the development and submission of Advanced Planning Documents (APDs).[59] There are three distinct types of APD submissions: Planning APD (P/APD), Implementation APD (I/APD), and APD Update (APD/U).[60] The type of APD required is based on the phase of the HIT investment project. The initial enhanced FFP request for this proposal should be submitted to CMS as a P/APD. FFP only applies to the Medicaid allocation of

[58] 42 CFR § 433.112(a)
[59] Ibid.
[60] 45 CFR § 95.611

an eligibility and enrollment system, however, and the State will be required to cost allocate appropriately to separate the Medicaid-related activities from other public assistance programs.

Policy Implementation Tool

Ohio Revised Code (ORC) 125.18 requires purchases of IT supplies and services to be approved by the DAS Office of Procurement Services (OPS).[61] As a result, the Medicaid IT investment described in this proposal meets the requirements of the State's procurement process. ODM, in coordination with DAS and its Office of Procurement Services (OPS) will plan, development, and release a competitive solicitation and subsequently award a deliverable-based IT services (DBITS) contract with a vendor to perform the services described in this proposal.

Request for Information

Prior to the solicitation process, ODM and DAS would first release a Request for Information (RFI) to solicit information from the technology vendor community that has specific or specialized knowledge about a particular subject matter.[62] Through this process, the State can better understand the technical capabilities necessary to perform the services described in this proposal and what information is necessary to develop and release the solicitation.

Solicitation

The solicitation will be administered through the RFP as described in the State Procurement Manual. Generally, the RFP process is comprised of eight steps beginning with the development of the RFP and ending with the award of the final contract. Figure 6 highlights each of these steps.

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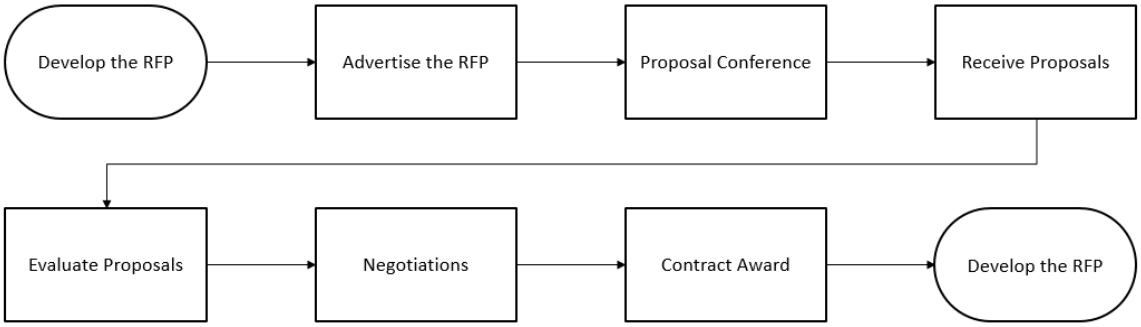
[61] Department of Administrative Services, *State of Ohio Procurement Manual*, Ver. 1 (Columbus, 2019), 14, https://procure.ohio.gov/pdf/PUR_ProcManual.pdf

[62] Ibid, 35.

Figure 6. State RFP Development Steps. Department of Administrative Services, *State of Ohio Procurement Manual*, 42-45.



The subsequent contract will be managed by ODM in coordination with DAS and JFS. Additionally, in order to ensure the availability of enhanced FFP under 42 CFR § 433.112, ODM will manage the project activities necessary to design, develop, and install the new IES.

Implementation Timeline

An exact implementation timeline will be based on a number of factors including development approach, implementation priorities, and external factors such as State legislative and administrative processes. However, based on the size and complexity of like systems (such as an MMIS), a fully implemented solution is likely to take 12 to 36 months to implement.[63] Like the existing Ohio Benefits system, however, a new solution can be implemented in phases to address areas of the system most impacted by deficiencies in the Ohio Benefits system.

Cost Considerations

In a competitive procurement, bidding contractors propose the cost to achieve the described scope of work. Additionally, given that this proposal presents the use of a new technology in the HHS space, a means for direct comparison does not currently exist. However, it

[63] Jason Duhon and Tamyra Porter, "Medicaid Management Information Systems" Increasing the Likelihood of Successful Procurement and Implementation," (white paper), Navigant (2018), https://guidehouse.com/-/media/www/site/insights/healthcare/2018/mmis-whitepaper.pdf, 4.

is possible to review component development information to understand the potential cost implications of the blockchain-based Medicaid eligibility application. To do so, we can look at each of the core components in addition to the underlying blockchain infrastructure. Because the State maintains an existing Systems Integrator (SI) solution, it will not need to procure new technology for the design, development, and installation of the blockchain-based Medicaid eligibility application.

Core application and supporting infrastructure

The cost to develop the core application—that is the blockchain-based solution itself—would likely fall between $450,000 and $1,500,000.[6465] The range estimate varies greatly depending on the complexity of the core application and the size and expertise of the bidder.[66] This development cost estimate does not account for node costs and transaction fees. Certain build options take advantage of cost sharing methods the State should consider during the RFP evaluation process. AWS' managed blockchain supports two blockchain frameworks: Hyperledger Fabric and Ethereum.[67] Using an existing blockchain framework would allow the State to take advantage of an already built platform on which its Medicaid eligibility application can be built. AWS' blockchain service offers a fully managed ledger database known as the Quantum Ledger Database (QLDB).[68] Although not a true blockchain framework, the QLDB shares many characteristics of a blockchain framework including immutability and

[64] Prateek Saxena and Sudeep Srivastava, "Blockchain App Development Cost," How To Guides, *Appinventiv*, June 5, 2019, https://appinventiv.com/guide/blockchain-app-development-cost/

[65] Amit Agrawal, "Blockchain Development: How Much Time And Cost Does It Require?," (blog) *Cyber Infrastructure*, https://www.cisin.com/coffee-break/Enterprise/blockchain-development-how-much-time-and-cost-does-it-require.html

[66] Prateek Saxena and Sudeep Srivastava, "Blockchain App Development Cost."

[67] "Blockchain on AWS," Amazon Web Services.

[68] Ibid.

cryptographically verifiable transactions, while maintain central ownership over the network.[69] Additionally, Microsoft's Azure platform offers similar support for existing blockchain frameworks, most notably Ethereum.[70] Because the State holds existing relationships with each of these technology providers, a blockchain-based application built within these environments will likely present as the most cost effective method.

HD Wallet

The cost to development the blockchain-based Medicaid eligibility application's HD wallet is generally based on the scope of the HD wallet and the number of supported platforms.[71] The base estimate, which would not include support for mobile platforms such as Apple's iOS and Google's Android, is approximately $26,500. To incorporate these mobile platforms, however, would raise the estimate to approximately $91,500. Table 6 breaks down these costs further.

Table 6. Cost to Develop a Blockchain Wallet

Task	Cost
Backend	$10,000
Android	$35,000
iOS	$30,000
Web/Desktop	$5,000
Design	$7,500
Project Management / Quality Assurance	$4,000
Total	$91,500

Source: Eugene Tarasenko, "How Much Does it Cost of Blockchain Implementation."

[69] "Amazon Quantum Ledger Database (QLDB)," Amazon Web Services, accessed on March 12, 2021, https://aws.amazon.com/qldb/?c=bl&sec=srv.

[70] "What is Azure Blockchain Service?," Azure, Microsoft Corporation, January 4, 2021, https://docs.microsoft.com/en-us/azure/blockchain/service/overview.

[71] Eugene Tarasenko, "How Much Does it Cost of Blockchain Implementation," (blog) December 27, 2019, *Merehead Company*, https://merehead.com/blog/how-much-does-it-cost-of-blockchain-implementation/

Smart Contract

Like the HD wallet, the cost to develop the smart contract varies based on the complexity of the smart contract itself. Some of the most basic smart contracts can cost under $1,000 to develop.[72] However, give the likely complexity of the smart contract necessary to determine Medicaid eligibility, the cost is more likely to range between $5,000 and $50,000.[73] Given the need to interact with external entities and databases to perform the eligibility transaction and store data, it is reasonable to assume the State would incur the maximum cost for the development of its eligibility smart contract.

The cost estimate for these core components represent the total costs incurred for the design, development, and installation of the blockchain-based Medicaid eligibility application. If the State were to leverage enhanced FFP, the State would receive federal funding at 90 percent for these activities. Table 7 breakdown these costs in terms of their State and federal shares.

Table 7. State and Federal Share of Estimated Application Development Cost

Component	State Share (10 percent)	State Share (10 %)	Federal Share (90 %)
Core Application and Supporting Infrastructure	$450,000 - $1,500,000	$45,000 - $150,000	$405,000 - $1,350,000
HD Waller	$91,500	$9,150	$82,350
Smart Contract	$5,000 - $50,000	$500 - $5,000	$4,500 - $45,000
Total	$141,500 - $1,641,500	$14,150 - $164,150	$127,350 - $1,477,350

[72] Ibid.
[73] Ibid.

Policy Analysis

In order to understand the effectiveness of the technology solution, it must be measured against the goals it sets out to achieve: (1) reduce the State's Medicaid eligibility determination error rate; (2) reduce the number of applications taking longer than 45 days to process; and (3) reduce the number of system defects. The use of smart contracts as a means for determining Medicaid eligibility brings with it benefits inherent to the 'if/when-then' statement-based process. This exchange-based validation allows eligibility claims to be automatically verified when the conditions outlined in the series of 'if/when-then' statements are met.[74]

Building these conditions into the Medicaid eligibility determination process will increase the likelihood of automatic validation and therefore reduce the number of errors resulting from complex code errors and manual workarounds. Further, reducing the need for manual application processing through both the smart contract conditions and the introduction of a mobile application or a mobile optimized website could increase the use of self-service-based data entry and therefore reduce the number of application being processed by State and County staff.

Although the use of an 'if/when-then' statement-based process can reduce the complexity of the code by simplifying the codebase's arguments, it is important to acknowledge that it is unlikely to eliminate system defects. In reality, it is practically impossible to ensure an absence of coding errors because, statistically, each computer program contains them.[75] However, eliminating system defects is not the goal; instead, the goal is to reduce the prevalence of system defects.

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[74] Abhinav Shashank "5 Benefits Of Using Blockchain Technology in Healthcare," HIT Consultant Media, January 29, 2018, https://hitconsultant.net/2018/01/29/blockchain-technology-in-healthcare-benefits/#.YGIqy69KiUl.
[75] Eliza Mik, "Smart contracts: Terminology, technical limitations and real world complexity" (2017) Law, Innovation and Technology, 9, (2), Research Collection School Of Law, 11.

Introducing blockchain technology into the Medicaid eligibility and enrollment space not only brings with it new considerations to existing questions but also introduces entirely new questions that must be looked at critically in appropriately determining the viability and effectiveness of the blockchain-based Medicaid eligibility application. Acknowledging and addressing these opportunities and challenges will further determine the utility of blockchain as an enterprise solution beyond HHS activities. Both the pros and cons of the proposed policy are further described in each of the following sections.

Policy Pros

Blockchain technology has the potential to address significant pain points in the current Medicaid IT landscape. These benefits, inherent to the blockchain infrastructure, include public-key cryptography, data immutability, data control, and the validation-based exchange. The remainder of this section introduces each of these benefits to this proposal.

Public-Key Cryptography

When this proposal introduced basic blockchain technology concepts, it referred to the means through which transactions and the corresponding data are secured. Public-key cryptography is "an encryption scheme that uses two mathematically related, but not identical, keys - a public key and a private key."[76] The public key is used to encrypt the transaction data and the private key is used to decrypt the transaction data. Additionally, it is infeasible to determine the private key based on the public key.[77] Therefore, sharing the public key does not put the transaction data at risk.

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[76] "What is Public-key Cryptography?," GlobalSign, *GMO Internet Group*, https://www.globalsign.com/en/ssl-information-center/what-is-public-key-cryptography.
[77] Ibid.

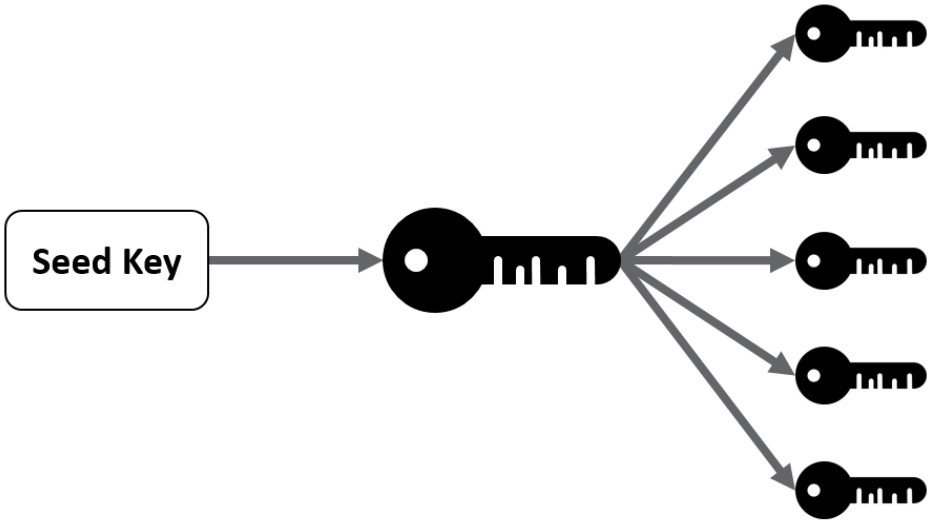
The use of public-key cryptography provides two benefits to the Medicaid enterprise: the ability to secure data and the ability to leverage digital signatures. Assuming that the private key has in fact remained private, only the individual holding the private key can decrypt the data, ensuring that sensitive data is necessarily confidential.[78] In addition to confidentiality, public-key cryptography reinforces data integrity protocols present in the blockchain infrastructure—discussed in the next section—by verifying the content that was originally encrypted through the use of the public key.[79]

In addition to ensuring data security, public-key cryptography makes the use of digital signatures possible by leveraging the private key as a "signature." Because the recipient of the private key should be the only individual who has access to it, it can serve as a non-repudiation signature.[80] Because of the complexity of private keys, they are typically physically stored (either through software or on hardware like a token). This can allow for a chain of custody to be established for certain beneficiaries who may be under the care of a guardian or legal instrument such as a power of attorney.

The use of HD wallets as a core component of the blockchain-based Medicaid eligibility application adds another layer of security to public-key cryptography. By using a master seed key to generate new "child" keys, a user—in this case the beneficiary—can mask their identity at the transaction level, making it more difficult to compromise the data and identify the data owner. Figure 7 depicts this parent/child relationship.

[78] Ibid.
[79] Ibid.
[80] Ibid.

Figure 7. Seed-Parent-Child Key Relationship



Further, the use of HD wallets makes backing up and restoring the wallet easier by generating a seed phrase. That is, a recovery phrase that allows the phrase holder to recreate the wallet identically.[81]

Immutability

Integral to any technology-based process is the quality and reliability of the underlying data supporting the processes being performed. Among the deficiencies identified with Ohio Benefits was the system allowing overwriting of eligibility data. The immutable nature of data on the blockchain render such a deficiency virtually moot. This immutability exists on the blockchain through the transaction validation process. Once the block is validated and added to the chain, it is secured in place through the cryptographic processes discussed earlier in this proposal. Attempting to alter a previously validated block effectively breaks the hash of all other transactions effectively breaking the previous validation computations and requiring all

[81] "HD Wallet," Kaleido, https://www.kaleido.io/blockchain-platform/hd-wallet.

subsequent transactions to be re-validated. Because of the amount of computing power necessary to perform the validation, altering existing blocks becomes virtually impossible.

The immutability of the blockchain introduces key benefits to the State's Medicaid enterprise. This immutability ensures that the data present on the blockchain is full and complete. Every data point on the blockchain remains available as a point-in-time log of the transaction it represents. Further, the validation process can be re-performed if necessary to confirm the validity of the transaction. Such permanency introduces data integrity and quality measures as a core component of the system's architecture and is not reliant on external processes. This permanence also allows for audits that are more efficient by creating a verifiable, unaltered history of the transactions and corresponding data on the blockchain. In addition, the permanence allows developers and programmers to trace defects or code errors more effectively and efficiently.

Data Control

In addition to the security benefits it brings, the use of an HD wallet as a core component of the blockchain-based Medicaid eligibility application puts the control of beneficiary data in the hands of the beneficiary themselves (or an authorized representative). The HD wallet collects and stores all Medicaid-related data associated with the account owner. This could include everything from the eligibility claim to diagnostic information and prescription information. The control of that data is placed in the hands of the private key holder, whether that be the beneficiary or an authorized representative, and allows that individual to determine how to share it and with whom.

Validation-Based Exchange

This automatic verification is made possible by the basic structure of the smart contract and its 'if/when-then' statements. The smart contract works in a manner that allows the contract

to be executed if the network (that is the nodes) agree that the conditions are met.[82] If a beneficiary's inputs return a series of 'yes' tokens indicating the beneficiary is eligible for Medicaid services, and the network nodes validate the block, the beneficiary can be automatically entered in the State's Medicaid rolls.

Additionally, the use of smart contracts can greatly simplify the code necessary to process the eligibility claim. The simplification can further allow automated processing by forcing the eligibility claim into a series of yes-no responses. Even in instances where the solution may need to validate against an external source, the eligibility claim is still broken down into simple 'if/when-then' statements. There will likely always be a need for some level of manual-touch processing for complex eligibility claims; however, increasing the automated processing for those who would otherwise not need manual review allows staff end users to focus on those more complex eligibility claims. In addition to increasing transaction automation, this code simplification can also greatly reduce the number of system defects. Combined with the immutability of the data, when a defect is discovered, the simplicity of the code is likely to reduce the amount of time necessary to implement a fix.

Policy Cons

The potential benefits to implementing a blockchain-based Medicaid eligibility application does not mean that it is free of potential drawbacks, therefore this proposal identifies those key drawbacks to its implementation. These key drawbacks of a blockchain-based Medicaid eligibility application include the data privacy, data storage, scalability, interoperability, and energy consumption. The remainder of this section introduces each of these potential drawbacks.

[82] Ibid.

Data Privacy

Previously this proposal discussed the security benefits of a blockchain-based Medicaid eligibility application —namely its data immutability; however, security is only one data consideration. Another data consideration—data privacy—brings with it a new set of challenges that must be considered when analyzing a blockchain implementation. Blockchain's distributed nature makes data privacy an exception, not the rule. In order to process the transactions onto the blockchain, each participating node needs to have access to the block's transaction data itself. Put simply, in a public blockchain, the entire blockchain is just that—public.

Regulation

Any Medicaid IT implementation must ensure compliance with HIPAA's Privacy Rule. The Privacy Rule "establishes national standards to protect individuals' medical records and other personal health information and applies to health plans, health care clearinghouses, and those health care providers that conduct certain health care transactions electronically."[83] Regulations such as the HIPAA Privacy Rule and the European Union's General Data Privacy Regulation (GDRP) are written from an assumption of traditional centralized data processing.[84] Such centralization goes against the basic architecture of the blockchain. The decentralized nature of the blockchain makes identifying responsible parties as defined by current regulations difficult and therefore can put a blockchain-based venture on a collision course with regulators.

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[83] "The HIPAA Privacy Rule," Health Information Privacy, *HHS.org*, updated December 10, 2020, https://www.hhs.gov/hipaa/for-professionals/privacy/index.html#:~:text=The%20HIPAA%20Privacy%20Rule%20establishes,certain%20health%20care%20transactions%20electronically.

[84] "Pritesh Shah, Daniel Forester, Carolin Raspe, and Hengeler Mueller, "Blockchain Technology: Data Privacy Issues and Potential Mitigation Strategies," legal note, *Practice Law*, https://www.davispolk.com/sites/default/files/blockchain_technology_data_privacy_issues_and_potential_mitigation_strategies_w-021-8235.pdf, 6.

Pseudonymity

One aspect of blockchain technology generally is the use of pseudonyms as a security measure. The deployment of public key cryptography means that each account interacting with the blockchain has a public "address." By itself that address is nothing more than an alphanumeric string of characters that acts as a user's pseudonym.[85] However, the use of a pseudonym still presents a privacy risk. By stringing together enough pseudonymous data points, it is feasible for one to obtain enough data points across a single pseudonym to ascertain detailed personal information about the individual that pseudonym represents.[86]

Storage

Blockchain technology supports limited on-chain storage.[87] For example, the entire BTC blockchain reached 311.43 gigabytes (GB) in December 2020[88]. The Ohio Benefits technical specifications include 113 terabyte (TB) Oracle database, however, making its storage capacity almost 365 times that of the entire BTC blockchain.[89] It is reasonable to assume that the Ohio Benefits system does not reach or perhaps even approach its data capacity; however, the sheer difference in data volume is representative of the challenge facing a pure blockchain implementation. The uncertainty rests in whether or not the blockchain can handle the data volume necessary to be a viable alternative to a traditional, centralized technology solution.

Scalability

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[85] "Anonymity and Pseudonymity In Crypto," Cryptopedia, *Gemini*, https://www.gemini.com/cryptopedia/anonymity-vs-pseudonymity-basic-differences

[86] Ibid.

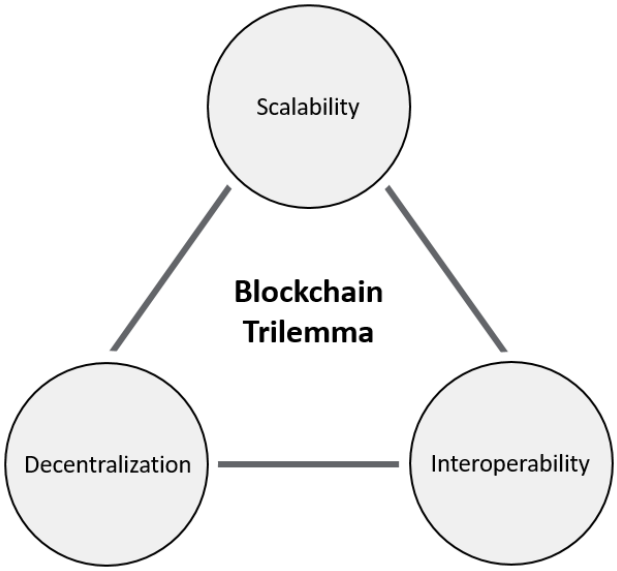
[87] Mehedi Hassan Onik, Satyabrata Aich, Jinhong Yang, Chul-Soo Kim, Hee-Cheol Kim, "Blockchain in Healthcare: Challenges and Solutions," in *Big Data Analytics for Intelligent Healthcare Management*, 197-226, Cambridge, MA: Academic Press, 2019.

[88] "Size of the Bitcoin blockchain from January 2009 to February 21, 2021," Financial Instruments & Investments, *Statista*, https://www.statista.com/statistics/647523/worldwide-bitcoin-blockchain-size/

[89] "Technical Assessment of the Ohio Benefits System RFP," Procurement Opportunity Search Detail, Department of Administrative Services.

Scalability can best be understood as "the measure of a system's ability to increase or decrease in performance and cost in response to changes in application and system processing demands."[90] Scalability represents a unique challenge to blockchain-based enterprise systems. Scalability represents one corner of the loose trilemma law that a blockchain can only have two of three IT properties: decentralization, scalability, and security. Figure 8 represents these three properties in the blockchain trilemma.

Figure 8. Blockchain Trilemma Law. Kaihua Qin, Arthur Gervais, "An Overview of Blockchain Scalability, Interoperability and Sustainability," (research paper) *EU Blockchain Forum*, https://www.eublockchainforum.eu/sites/default/files/research-paper/an_overview_of_blockchain_scalability_interoperability_and_sustainability.pdf, 3.



Two factors important to the scalability of the blockchain are the "block time interval" and the "block size."[91] The block time interval is the expected time that it takes to mine (validate) a block. Block time intervals for established cryptocurrencies BTC and ETH are well established. Reducing the block time interval can increase performance but at the risk of its inherent security

[90] "Scalability," Gartner Glossary, *Gartner, Inc.*, https://www.gartner.com/en/information-technology/glossary/scalability#:~:text=Scalability%20is%20the%20measure%20of,application%20and%20system%20processing%20demands.

[91] "An Overview of Blockchain Scalability, Interoperability and Sustainability," (research paper) *EU Blockchain Forum*, 3.

characteristics. The blockchain network would be more susceptible to a split.[92] A split—commonly referred to as a fork—can occur for a number of reasons including when the software used by different nodes no longer aligns or there is not a unanimous decision among nodes (such as on block time interval or block size).

Interoperability

Interoperability can be understood as the ability for a device [system] from one manufacturer to work with one from another.[93] Interoperability is what allows one discrete technology system to send and receive information from another. Understood this way, interoperability is an integral principle to a functioning MMIS. This is especially true in healthcare and more specifically in Medicaid IT. MMIS and eligibility and enrollment systems are discrete systems that are not (typically) procured, designed, developed, or installed simultaneously. As a result, these systems require the ability to interface with one another in order to process Medicaid claims. Further, the eligibility and enrollment system must interface with multiple internal and external resource systems to obtain and/or validate information regarding the beneficiary, making interoperability for any blockchain-based Medicaid eligibility application imperative to a successful installation.

Blockchain development has largely existed in disparate ecosystems or on different and evolving platforms.[94] Developing blockchain technology in this manner has largely prevented the emergence of common standards.[95] Without common standards, it becomes exponentially more

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[92] Ibid, 4.
[93] "Interoperability," Gartner Glossary, *Gartner, Inc.*, https://www.gartner.com/en/information-technology/glossary/interoperability#:~:text=The%20ability%20for%20a%20device,work%20with%20one%20from%20another.
[94] Matthew White, Oliver Sykes, and Nisha Ramisetty, "Accelerating Blockchain From Proof of Concept to Implementation," (conference paper) PwC, https://www.pwc.com/m1/en/services/assurance/documents/accelerating-blockchain.pdf
[95] Ibid.

difficult for other system developers to incorporate APIs that allows blockchains to seamlessly interface with their respective systems. This could lead to a significant amount of work just to ensure that any blockchain-based Medicaid eligibility application is able to interface with the numerous internal and external systems necessary for it to perform its functions.

Energy Consumption

The primary means for validating transactions on a blockchain is through a concept known as Proof-of-Work (PoW). The PoW is a type of cryptographic computation that invoices scanning for a value that when solved, is verified by others on the blockchain. The PoW computation is meant to be achievable but requires a significant amount of central processing unit (CPU) effort to perform. Because of the complexity of the PoW computation, it consumes a significant amount of energy. In August 2018, Princeton University Associate Professor Arvind Narayanan testified to the Senate Committee on Energy and Natural Resources that the BTC PoW computations—better known as mining—expended an estimated 5 gigawatts (GW) of electricity per day.[96] At the time, this figured represented just under 1 percent of the world electricity consumption.[97]

The Cambridge Centre for Alternative Finance, which maintains the Cambridge Bitcoin Electricity Consumption Index (CBECI), estimates BTC blockchain's current electricity usage at approximately 15.65 GW. The CBECI further extrapolates this information into annualized electricity consumption, estimating that the BTC blockchain's annual electricity consumption at approximately 133.39 terawatt-hours (TWh). Figure 9 provides these estimates, including the lower and upper bound limits of the CBECI calculations.

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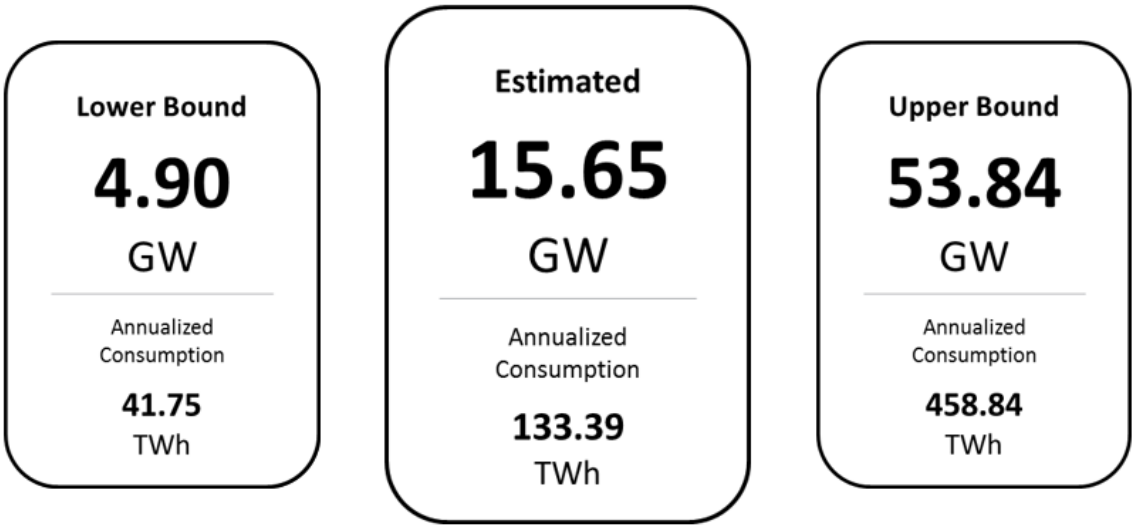
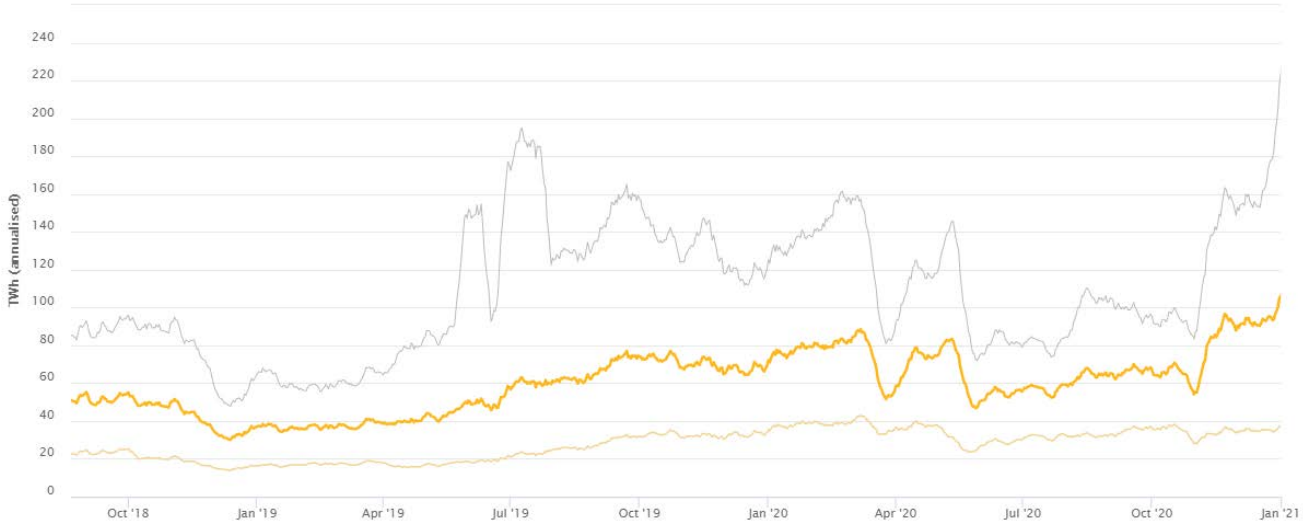
[96] *Committee on Energy and Natural Resources Hearing on Energy Efficiency of Blockchain and Similar Technologies*, 115th Cong. 2d sess., August 21, 2018.
[97] Ibid.

Figure 9. BTC Blockchain Electricity Consumption Estimates. "Cambridge Bitcoin Electricity Consumption Index," Cambridge Centre for Alternative Finance, Judge School of Business, University of Cambridge, https://cbeci.org/



From August 2018 through January 2021, CBECI estimated a 108 percent increase in the electricity consumption of the BTC blockchain from an estimated 50.87 TWh to an estimated 105.98 TWh. Figure 10 charts the changes in BTC blockchain's estimated electricity consumption over time.

Figure 10. BTC Blockchain Electricity Consumption Estimates Over Time. "Cambridge Bitcoin Electricity Consumption Index," University of Cambridge.



Although the comparison to the BTC blockchain is not a direct comparison, the energy consumption demonstrated by the BTC blockchain highlights the significant energy necessary to complete the PoW computations. Because these computations are necessary for the validation of a new block being added to the blockchain, each new eligibility transaction could consume a significant amount of electricity and therefore place stress on the State's electrical grid and overall energy needs.

Political Analysis

To examine the political feasibility of procuring a blockchain-based Medicaid eligibility application, it is important to understand the stakeholder groups integral to the policy's implementation. Core to the adopting of the proposal is the willingness to embrace technological innovation and mainstream adoption of the disruptive technology. Two of the Big Four accounting firms—PricewaterhouseCoopers (PwC) and Deloitte—conduct global surveys on the adoption and use of blockchain technology. In its 2018 Global Blockchain Survey, PwC posited that enterprise software platforms were increasingly shifting toward blockchain integration and blockchain-based platforms.[98] Additionally, the survey cited healthcare a potential future industry leader in blockchain, with healthcare and government ranked fourth and fifth among industries leading in blockchain.[99]

In its 2020 Global Blockchain Survey, Deloitte presented a measureable shift in industry sentiments around blockchain technology. Between 2018 and 2020, survey responses rose from 43 percent to 55 percent when asked how they currently view the relevance of blockchain to your organization.[100] When asked their level of agreement or disagreement with the broad scalability and mainstream adoption of blockchain technology, 88 percent of respondents agreed.[101] Further, blockchain adoption in production environments increased from 23 percent in 2019 to 39 percent in 2020.[102]

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[98] "PwC's Global Blockchain Survey 2018," Blockchain, PricewaterhouseCoopers, https://www.pwc.com/gx/en/industries/technology/blockchain/blockchain-in-business.html
[99] Ibid.
[100] Deloitte's 2020 Global Blockchain Survey," Deloitte Insights, Deloitte Development LLC, https://www2.deloitte.com/content/dam/insights/us/articles/6608_2020-global-blockchain-survey/DI_CIR%202020%20global%20blockchain%20survey.pdf, 4.
[101] Ibid, 5.
[102] Ibid, 7.

Further, a willingness for Ohio Medicaid program, funding justification, and the proposal authorizing mechanism will be critical to the execution of this proposal. This analysis will focus on five stakeholder groups: the State, which includes its cabinet agencies the Office of the Governor, and the Ohio General Assembly, CMS, and the beneficiary community.

The State

Government Technology (GovTech), a publication on information technology in the public sector, publishes a biennial Digital States Survey that evaluates "states' use of technology to improve service delivery, increase capacity, streamline operations and reach policy goals and assigns each state a grade based on quantifiable results."[103] In 2020, GovTech graded Ohio at an A, citing the DeWine Administration's technology priorities in "the deliberate integration of citizen services, data governance and data transparency."[104] The State's continued leadership in technology innovation in government service delivery lends itself to support among its key stakeholders: its cabinet agencies, the Office of the Governor, and the Ohio General Assembly.

State Cabinet Agencies

The State does not have a single overarching HHS agency. Instead, the State implemented an HHS governance model that included the State's eight HHS agencies.[105] The eight HHS cabinet agencies are the Department of Aging (ODA), Department of Developmental Disabilities (DODD), Department of Health (ODH), JFS, ODM, Department of Mental Health and Addiction Services (MHAS), Opportunities for Ohioans with Disabilities (OOD), and

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[103] Janet Grenslitt, "Digital States Survey 2020 Results Announced," GovTech, e-Republic, October 28, 2020, https://www.govtech.com/cdg/digital-states/digital-states-survey-2020-results-announced.html

[104] Lauren Harrison, "Digital States Survey 2020: Cloud Is More Critical Than Ever," GovTech, e-Republic, October 23, 2020, https://www.govtech.com/computing/digital-states-survey-2020-cloud-is-more-critical-than-ever.html?page=4

[105] Office of Health Transformation, "Ohio Health and Human Services Transformation Framework," Office of the Governor of Ohio, https://www.ohca.org/uploads/old/news/OHT_Framework.pdf

Department of Youth Services (DYS). Although the State's HHS footprint encompasses eight cabinet level agencies, ODM is primarily responsible for managing the technology systems related to the Medicaid program, including Ohio Benefits. Additionally, as the primary procurement agency for the State, DAS also plays an integral role in administering contracts on behalf of State agencies—including ODM.

Department of Medicaid

ODM has documented its dissatisfaction with the current Ohio Benefits system since the DeWine Administration took office, culminating in the findings Director Corcoran presented in her year-end memorandum to the governor. In introducing those findings, Director Corcoran described them as part of the "messes" the DeWine Administration inherited from its predecessor.[106] ODM has also regularly testified on the state of Ohio Benefits Joint Medicaid Oversight Committee (JMOC), including fielding questions regarding the agency's efforts to rectify the system's deficiencies and their negative impacts on constituencies.[107]

In addition, ODM is currently in the process of modernizing its Medicaid Enterprise System (MES). The new future-state system—the Ohio Medicaid Enterprise System (OMES)—is a program to replace the State's current Medicaid claims payment system known as the Medicaid Information Technology System (MITS).[108] ODM's stated goal is to replace MITS with a "modular system composed of best-in-breed applications and technology."[109] Additionally, because Ohio Benefits serves as a central component of the Ohio Medicaid Enterprise (OME), ODM can leverage this modernization program to reprocure Ohio Benefits. Figure 11 shows how Ohio Benefits fits into the larger OME.

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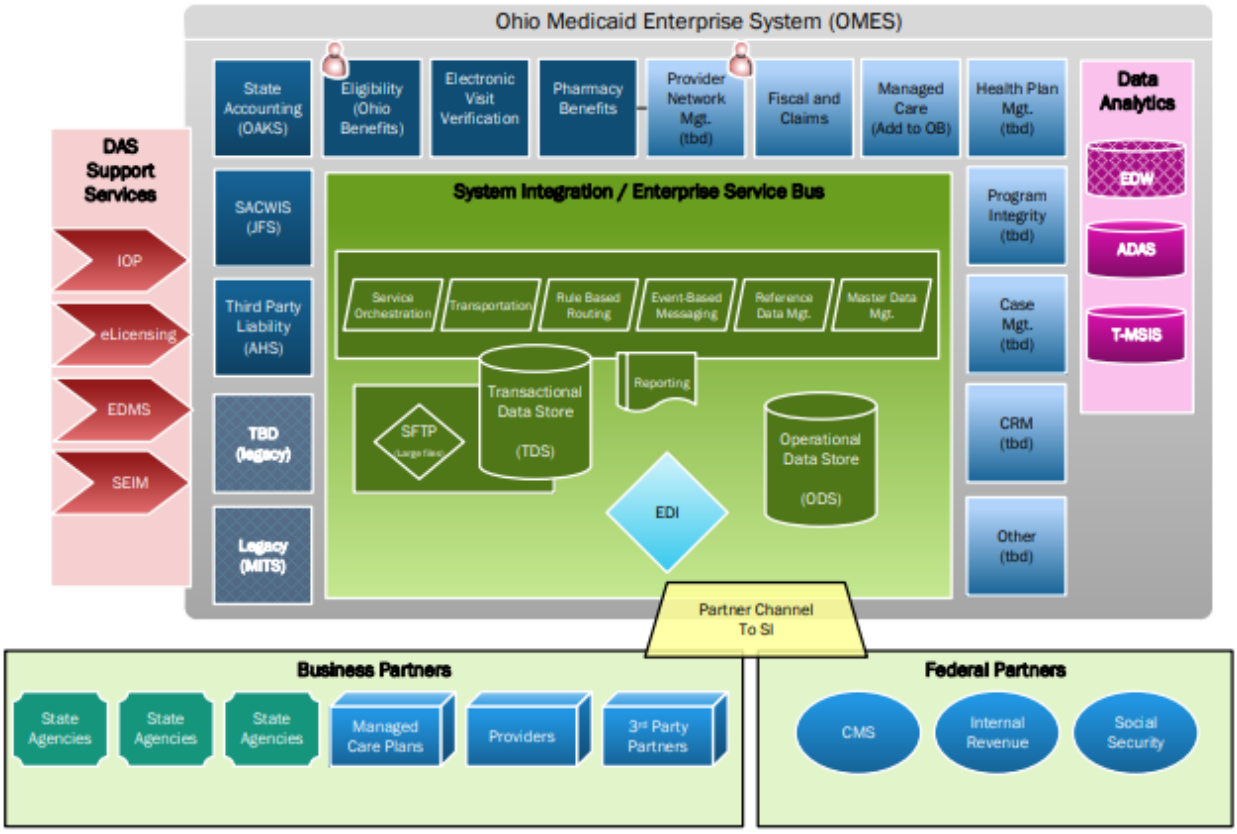
[106] Corcoran, *2019 Year End Summary*, 1.
[107] Joint Medicaid Oversight Committee (JMOC), "JMOC Meetings," Ohio General Assembly, http://jmoc.state.oh.us/meetings
[108] "MMIS Concept of Operations," ODM (Columbus: 2019), 25.
[109] Ibid.

Figure 11. OMES Modular Architecture. "MMIS Concept of Operations," ODM (Columbus: 2019), 55.



Undertaking such a multi-year modernization program demonstrates the agency's commitment to modernizing its service delivery technologies.

Department of Administrative Services

As the agency responsible for competitive procurements statewide, DAS plays an integral role in the procurement process, including approving and executing contracts and purchase orders. In the case of Ohio Benefits, DAS manages the program on behalf of the State's HHS agencies administering public services. In response to multiple State and federal audits presented within this proposal, the State procured a technical assessment of the Ohio Benefits system, development methodology, and staffing. The technical assessment, introduced in History and Background, includes identifying risks related to the availability and data confidentiality and

recommended mitigation strategies for identified risks.[110] Further, DAS awarded the technical assessment to allow CMA to complete its assessment work prior to the expiration of the current Ohio Benefits contract currently in place with Accenture. Coupled with the well-documented challenges with the Ohio Benefits system, this provides DAS the opportunity to leverage the assessment results as additional evidence justifying procuring a new Medicaid IT solution.

Office of the Governor

Redesigning a large IT system—especially one encompassing multiple cabinet-level agencies—begins and ends with the governor. The DeWine Administration has signaled aggressive support for modernizing the State's IT infrastructure through its prioritization of InnovateOhio. InnovateOhio was developed to bring redesign and streamline how the State delivered public services.[111] Specifically, InnovateOhio aimed to use new technologies in Medicaid and healthcare data to improve overall health outcomes. Among the technologies being explored for use in government activities is blockchain technology.[112]

Procuring a new Medicaid IT platform such as the blockchain-based eligibility platform presented in this proposal allows the DeWine Administration to advance these goals at a faster pace than attempting to retrofit new ideas with old technology. Given the stated goals of the InnovateOhio initiative, introducing disruptive technology such as blockchain into the State's Medicaid eligibility system aligns with Governor DeWine's priorities in modernizing the State's public service delivery.

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[110] "Technical Assessment of the Ohio Benefits System RFP," Department of Administrative Services.
[111] Phil Goldstein, "Innovate Ohio Looks to Modernize Public Services," New and Events, InnovateOhio, March 25, 2019, https://innovateohio.gov/wps/portal/gov/innovate/news/news-and-events/io-032519.
[112] Ibid.

Ohio General Assembly

The State's ability to implement the proposal requires budget authorization from the Ohio General Assembly and, more specifically, the standing committees responsible for the review of the executive budget proposal. These committees are the House Finance Subcommittee on Health and Human Services and the Senate Finance Committee. During the SFY 2018-19 operating budget debate, HB 49 was heard 13 times in the House and 10 times in the Senate while maintaining the language authorizing the Medicaid IT investment.[113] Further, the SFY 2020-21 operating budget was heard nine and 14 times respectively while maintaining its Medicaid IT investment-authorizing language.[114]

In addition to precedent authorizing Medicaid IT investments, the Ohio General Assembly maintains JMOC, which is the standing committee established to oversee the State's Medicaid program.[115] Further, JMOC is tasked with "…improving quality of care and health outcomes for individuals enrolled in the state's Medicaid program" while performing its oversight function.[116] The language authorizing the procurement of the state pharmacy benefit manager included language requiring the Medicaid director to report to JMOC on certain milestones of the project.[117] Offering similar language gives JMOC a vehicle for ensuring its involvement in such a large-scale program. As a result, JMOC is uniquely positioned to advocate for—and oversee—the implementation of Medicaid IT investments that are aimed at improving the overall health of citizens while improving service delivery.

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[113] The Ohio Legislature, "House Bill 49: Committee Activity," 132th Leg., https://www.legislature.ohio.gov/legislation/legislation-committee-documents?id=GA132-HB-49
[114] The Ohio Legislature, "House Bill 166: Committee Activity," 133rd Leg., https://www.legislature.ohio.gov/legislation/legislation-committee-documents?id=GA133-HB-166
[115] JMOC, "Welcome to JMOC," Ohio General Assembly, http://jmoc.state.oh.us/home
[116] Ibid.
[117] Creates FY 2020-2021 operating budget, Ohio H.B. 166, 133rd Leg. (OH 2019).

Critical to funding the proposal is to obtain CMS approval for enhanced FFP for the design, development, and installation of the blockchain-based platform. Because we know that CMS extended enhanced FFP for the development of new eligibility platforms on an ongoing basis, the State will need to submit its justification for the project through the APD process (see *Policy Authorization Tool*). This ongoing extension and established process for approval demonstrates that CMS is a willing partner in State's technology implementation efforts. In a December 2020 presentation to its APD Community of Practice, CMS linked its approval of these technology projects to the incorporation of outcomes into its APDs.[118] Specifically, CMS presented the following:[119]

- Outcomes describe the measurable improvements to a state's Medicaid program that should result from the project the state is undertaking.
- Outcomes should support the priorities of the Medicaid program, be directly enabled by the state's IT project, and be stated in the APD.
- If a project has an already-approved APD that doesn't include applicable outcomes, the state should work with CMS to identify and confirm outcomes as part of the APD-update process or during preparation for a review.
- CMS is encouraging states to develop outcomes that are measureable, achievable, and that reflect the short-term goals of the MES project.

Effectively, CMS is signaling that IT projects will not be automatically granted enhanced FFP and will instead be required to demonstrate the project's merits in improving the Medicaid program.

In recognizing this, the proposal sought to articulate three primary goals—or desired outcomes—that should result from the project: (1) reduce the State's Medicaid eligibility

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[118] Medicaid Enterprise Team, "Incorporating Outcomes into APDs" (presentation to the MES APD Community of Practice, December 10, 2020), https://www.medicaidhitechta.org/CommunitiesofPractice/MESAdvancePlanningDocument(APD)CoP.aspx.
[119] Ibid.

determination error rate; (2) reduce the number of applications taking longer than 45 days to process; and (3) reduce the number of system defects. By articulating these desired outcomes in the State's APD request, the State gives itself the best possible chance of receiving enhanced FFP to undertake the design, development, and installation of the blockchain-based Medicaid eligibility application.

Beneficiary Community

The challenges facing the beneficiary community were well documented in CCS' survey findings published in November 2020. Additionally, CCS published a separate paper in January 2019 documenting its findings on the challenges community assisters faced when the programs supported by the Ohio Benefits system expanded to those offered through JFS. In that paper, CCS found that Ohio Benefits "does not provide a dedicated portal for trusted, community assisters to submit applications on behalf of their clients."[120] In both its January 2019 paper and November 2020 survey findings, CCS presented recommendations to address the needs of community assisters and beneficiaries alike. These recommendations and needs include:[121] [122]

- Improve the Ohio Benefits Self-Service Portal using human-centered design principles.
- Improve customer service and reduce wait times.
- A way to initiate an application on behalf of a client without having to create a customer account.
- A mechanism to track submitted applications for client follow up and troubleshooting.
- Automated feedback from the eligibility system on the ultimate outcome of submitted application and associated reasons for denial.
- Redesign county workflows to process benefit applications faster.

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[120] Rachel Cahill, "Ohio Community Groups Face Challenges Helping Needy Ohioans Navigate New Ohio Benefits System," Center for Community Solutions, January 14, 2019, https://www.communitysolutions.com/research/ohio-community-groups-face-challenges-helping-needy-ohioans-navigate-new-ohio-benefits-system/

[121] Ibid.

[122] Rachel Cahill and Hope Lane, *Prioritize Customer Needs in Ohio Benefits System: Findings and Recommendations from the Ohio Benefits User Experience Study*, 2.

Each of these recommendations are achievable through the design and development of the blockchain-based eligibility platform described in this proposal.

To ensure that these recommendations are considered, and any additional recommendations that might arise as the blockchain-based eligibility platform is developed, the State will need to engage with beneficiary and community representatives throughout the process much like was done during the design, development, and installation of the State's Electronic Visit Verification (EVV) system.[123] By engaging with the stakeholder community through the project's lifecycle, including after installation, ODM can mitigate stakeholder apprehension and obtain buy-in to the project's desired outcomes.

[123] "Electronic Visit Verification," Initiatives, *Ohio Department of Medicaid*, https://medicaid.ohio.gov/INITIATIVES/Electronic-Visit-Verification

Recommendation

The Ohio Benefits system has presented significant challenges to the State's Medicaid programs and public service delivery at-large. Well documented and persistent system defects, determination errors, and processing backlog place undue burden in long application waiting periods, incorrect eligibility determinations, and improper payment dispositions. State and county staff have had to catalog nearly 2,000 system workarounds. All of which represent significant losses to the Ohio Medicaid Program. It is apparent that action is necessary in order to stabilize the technology supporting Ohio Medicaid and the impending expiration of the current technology contract affords the State the opportunity to explore its options.

This proposal presented a series of potential challenges to its adoption that, if gone unaddressed, represent significant risk to its success. However, these challenges are solvable with existing technologies and therefore it is recommended that this proposal be supported for implementation. The remaining sections present solutions to each challenge.

Solving Data Privacy

Arguably, one of the most critical challenges to the successful implementation of a blockchain-based eligibility platform is that of data privacy. Not only is data privacy generally at the forefront of the conversation on big tech, but it is also a foundational tenant to the HHS landscape. Blockchain technology brings with it the use of pseudonymity. Blockchain's way of ensuring transaction are kept discrete. However, pseudonymity is not anonymity and therefore PHI is at risk of exposure. However, this proposal also presented the use of the HD wallet as a core component of technology solution. Specifically, the HD wallet acts as the beneficiary's identification profile.

The HD wallet employees a parent-child key relationship at the transactional level. By using a master seed key to algorithmically generate a new public key for every transaction, it

makes tracing transaction on the blockchain by public key virtually impossible. Such a process brings pseudonymity as close to anonymity as is technologically possibly, putting data on the blockchain at no greater a risk—and perhaps at less of a risk—than individual password management.

Solving Storage Capacity

Healthcare records represents a significant amount of data. This proposal presented the challenge that creates for a blockchain-based, enterprise level solution to exist in the HHS space. The data capacity issues, however, exist *on-chain*. Off-chain storage has emerged as a viable alternative to the storage capacity limitations of the blockchain.[124] Off-chain storage facilities allow the blockchain to interface with a database to store sensitive data, protecting it with cryptographic encryption.[125] Ohio, through its IOP, State of Ohio Computer Center (SOCC), and associated backup facilities, already possess the storage facilities necessary to support off-chain data storage.

Solving Scalability

Scalability is arguably the most important challenge to blockchain implementation. Previously, this proposal introduced it as one side of the Blockchain Trilemma Law (see figure n). There are, however, several ways in which scalability can be solved in the blockchain environment. Gagandeep Kaur and Charu Gandhi identify these scalability solutions into three primary categories: chain partitioning-based scalability, Directed Acyclic Graphs (DAGs)-based

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[124] "Blockchain in Healthcare: Challenges and Solutions," in *Big Data Analytics for Intelligent Healthcare Management*, 197-226
[125] Ibid.

scalability, and horizontal scalability through sharding.[126] For the purposes of the blockchain-based eligibility solution, this proposal presents two: off-chain scalability and sharding.

Off-Chain Scalability

Off-chain scalability allows for transaction processing to occur outside of the blockchain itself.[127] In off-chain scalability, not all of the intermediate states of the respective transactions are broadcast on the blockchain. Instead, only the final state is broadcast across the blockchain. In the instance of off-chain transaction processing, the consensus mechanism is done locally in the "off-chain" environment.[128] Such off-chain transaction processing can solve the challenge of scalability. One such solution—the Raiden Network—is specific to ERC20-compliant token transfers on the Ethereum blockchain.[129]

Sharding

In blockchain, when the history and state of the blockchain are partitioned, those partitions are known as "shards."[130] Each shard chain manages itself and has its own transaction history. Generally, transactions on a shard only impact its respective shard; however cross-shard communication can allow transactions occurring on one shard to impact another shard.[131] In a basic sense, partitioning the blockchain into separate shards allows a greater volume of transactions in parallel on each shard than what would be possible on the main, linear blockchain.[132]

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[126] Gagandeep Kaur and Charu Gandhi, "Scalability in Blockchain: Challenges and Solutions," in *Big Data Analytics for Intelligent Healthcare Management*, 373-406, Cambridge, MA: Academic Press, 2019.
[127] Ibid.
[128] Ibid.
[129] Ibid.
[130] "Sharding," Ethereum 2.0 Roadmap, *EthHub*, November 16, 2019, https://docs.ethhub.io/ethereum-roadmap/ethereum-2.0/sharding/
[131] Ibid.
[132] Ibid.

Solving Interoperability

Interoperability is a key challenge to address in HHS eligibility. In order to determine eligibility, the determination application must interface with State, federal, and other third-party databases in order to verify information. Further, the eligibility platform must integrate into the MMIS in order to allow it to check eligibility point-in-time for the purposes of authorizing and paying claims. This proposal presents a system integration component as a core component of the technology solution. The systems integrator can act as an oracle, or the third party agent that transfers external data to the blockchain for on-chain use.[133] Similarly, the system integrator can act as an API gateway that organizes the information requests from the eligibility platform to the respective third-party database.[134] Either role taken by the systems integrator allows the blockchain to interact with the requisite third-party databases and systems necessary to perform its functions.

Solving Energy Consumption

Energy consumption raises significant concerns regarding the ability to leverage blockchain technology at a large scale. The primary consideration regarding the energy consumption of the blockchain lies in the computing power necessary to perform the PoW computations. In 2012, Scott Nadal and Sunny King introduced a new consensus validating methodology—Proof-of-Stake—in their paper, "PPCoin: Peer-to-Peer Crypto-Currency with Proof-of-Stake."

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[133] "Interoperability," Redesigning Trust: Blockchain Deployment Toolkit (module), Supply Chain Forum, *World Economic Forum*, https://widgets.weforum.org/blockchain-toolkit/pdf/interoperability.pdf, 9.
[134] Ibid, 10.

Proof-of-Stake

Proof-of-Stake (PoS) removes the computational requirements of the PoW and replaces it with a stake requirements—or how many tokes a particular node has in the its wallet.[135] The percentage of the block a node is able to validate is directly proportionate to the percentage of tokens the node holds. For example, if a particular node holds 15 percent of the tokes available on the blockchain, the node can validate 15 percent of the transaction because that is the node's "stake" in the blockchain.[136] Further, a node is not rewarded in the same way for validating the transaction. Instead of earning a block reward, validator nodes earn a transaction fee.[137]

By removing the computational power requirements from the transaction validation process, PoS significantly reduces the energy consumption necessary to operate a blockchain-based enterprise level technology solution.[138] In November 2019, Ethereum released its plans for the ETH 2.0 network and the introduction of the PoS transaction validation process into one of the largest blockchain platforms in operation.[139] Such a shift in the transaction validation process means that the energy consumption concerns of the PoW becomes irrelevant to the policy decision.

Introducing disruptive technologies such as blockchain into the HHS space presents unique challenges that must be considered in order to be successful. This proposal sought to present and subsequently offer solutions to each of the most pressing challenges facing such a technology adoption. Combining these solutions with the advantages such a technology brings to eligibility determination, and the State's prioritization of technological innovation make

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[135] Akash Takyar, "The Proof of Work VS Proof of State: An In-Depth Discussion," LeewayHertz, https://www.leewayhertz.com/proof-of-work-vs-proof-of-stake/.
[136] Ibid.
[137] Ibid.
[138] Ibid.
[139] "Proof-of-Stake," Ethereum 2.0 Roadmap, *EthHub*, November 16, 2019, https://docs.ethhub.io/ethereum-roadmap/ethereum-2.0/proof-of-stake/

introducing blockchain technology into the State's Medicaid program a viable solution. Therefore, given strengths presented in the proposal, and the solutions presented to address the identified challenges, it is recommended that ODM and DAS support the Medicaid technology investment presented in this proposal.

Curriculum Vitae

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Christopher is a Manager and Prosci® Certified Change Practitioner (CCP) in BerryDunn's Government Consulting Group. Christopher specializes in federal regulatory compliance and certification of technology systems for state Medicaid agencies. Current and past projects include the Ohio Department of Administrative Services, the Ohio Department of Medicaid, the Missouri Department of Social Services, and the New Hampshire Department of Health and Human Services.

In addition to more than a decade of professional experience, Christopher worked in politics and public policy for four years. Christopher earned an A.A. from Lakeland Community College in Kirtland, OH, a B.A. in Political Science, with a concentration in international relations, from The Ohio State University in Columbus, OH, and is pursuing an M.A. in Public Management at Johns Hopkins University in Baltimore, MD.